Introduction to Plumbing System

Plumbing refers to :—

- Ensure safe delivery of water
- Installation and Maintenance of any system that conveys fluid for a wide range of applications
- use of pipes, valves, plumbing fixtures, tanks, and other apparatuses to convey fluids.
- ~~use~~ Removal of used water and water borne wastes from the pipelines
- Installation and maintenance of storm water or roof drainage system components.

Principal Parts of Plumbing System

— Water Supply System
— Drain-Waste-Vent System
— Plumbing fixtures

- Water Supply System :
  - Raw water (untreated) is collected from a surface water source.
  - Raw water (untreated) is ~~collected~~ collected ~~from a~~ groundwater source.

— Untreated water is filtered and treated in treatment plants

— The filtered water is sent to storage points like watersheds or reservoirs

— Water from storage points are distributed by a network of piplines

— from the storage tank or reservior at users' end, they select to use hot or cold water using Hot water System or cold water system.

- **Drain - Waste - Vent System**

— This enables removal of sewage and grey water from a building

— It helps in maintaining proper air pressure in the system

— Example - Soil System,

- **Principle Parts of Plumbing system:**

— A plumbing fixture is a detachable & exchangable device in Plumbing ~~System~~.

— It can be connected to a plumbing system to deliver and drain water.

— Example: Bathtub, Water Closet (WC), Lavatory (LAV), etc.

Different types of Plumbing System.

ⓐ Gravity System (Drainage, Waste & Vent)
ⓑ Pressure System (Potable & Non-potable water)
ⓒ Medical Gas System
ⓓ Natural Gas (NG)

⇒ Gravity System:

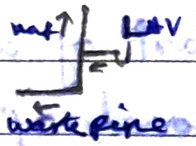
Drain-Waste-Vent System (DWV System)

- Part of a plumbing system responsible for removal of sewage and grey water from a Building
- As the water runs down, proper venting avoids vaccum from being created
- Proper venting removes bad smell from the drainage line
- Air must be allowed into the waste pipe through a roof vent.
- Waste in produced from fixtures such as toilets, sink, showers, etc.
- Slop is required in DWV system for smooth flow of waste & vent under additional force

Different type of Drainage System

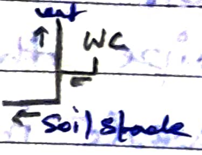
Waste System:

- The discharge from any fixture, appliance, area, or appurtenance that does not contain fecal matter.
- Waste is from showers, basins, kitchen sinks, washing machines etc.
- Waste by this system is also called Grey-waste

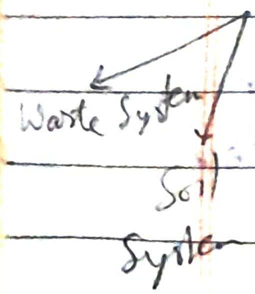


Soil System:

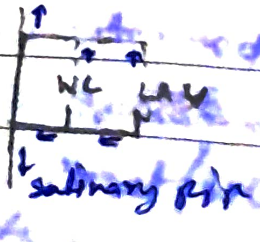
- A pipe that conveys sewage containing fecal matter to the building drain or building sewer.
- Soil water or sewage is from WCs and urinals. This is also called Black-water



Sanitary System:

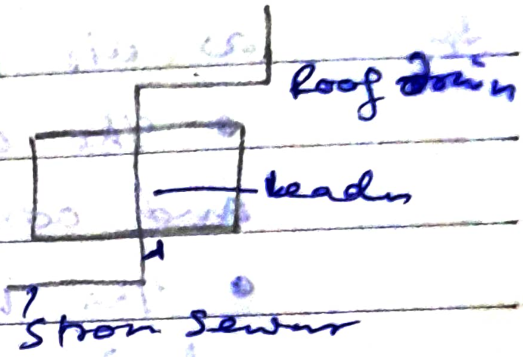


- Sanitary water or sewage is from WCs, Urinals & Lavatory also
- When running horizontally, Sanitary water pipes should be run at uniform slop.



Rainwater leader System (storm water)

- A sewer that conveys rainwater, surface water, subsurface water and liquid waste



Grease Waste System:

- Plumbing fixtures containing pools of rotting food waste
- Fats, Oils, and Grease (FOG) are lighter than water and float to the top of the ~~tanks~~
-

Overflow System:

- A plumbing feature that is added to prevent our fixture from overflowing with water in case of a block.

Acid waste:

- A waste which is generated from laboratories in industry and in educational centers.

Condensate Drain:

- The line is an exit route for moisture collected by the evaporator coil as air passes over it
- The coil removes humidity from the air and converts into water.
- The water drains into the condensate drain pan, enters the drain line, travels down the drain pipe
- Water gets deposited outside near the AC's outdoor unit

Pump Discharge:

- This line is mostly used to discharge waste from underground or lower till the point
- Until it reaches a point where it can be drained by gravity

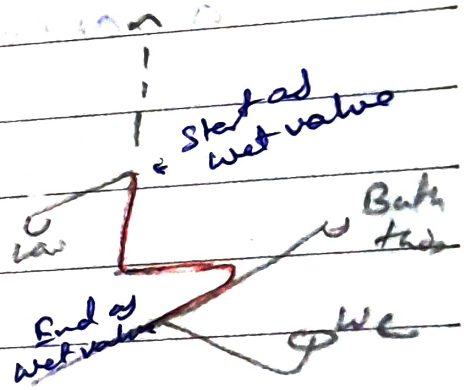
→ Vent System

Vent:

- To maintain the proper Air blance inside the waste line
- To helps for moving waste water through the drainage pipes smoothly
- To allows waste water gas and bad odor to escape from drainage network

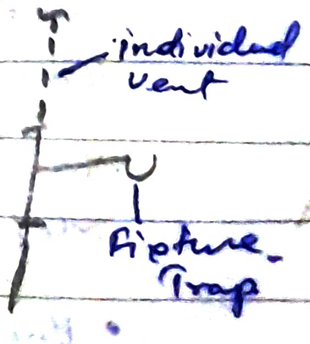
Wet Vent:

- Special method of venting in generally used in dwelling
- Provides traps protection for plumbing fixtures
- Can be vertical or horizontal it can be used on a stack or a flat plumbing installation.

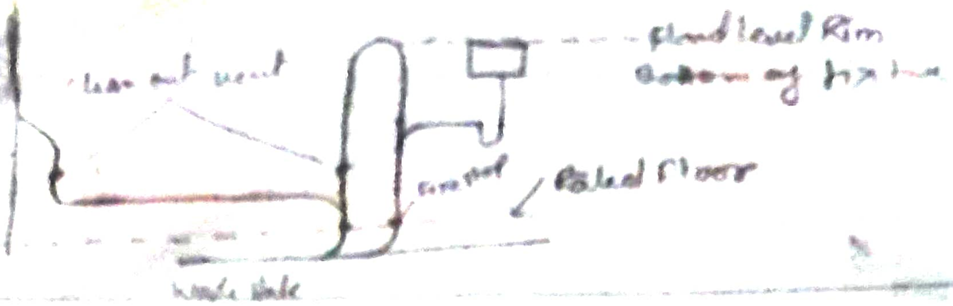


Individual vent:

- Vertical pipe that is continuation of the drainpipe to which it connects
- Also called a back vent or a continuous vent

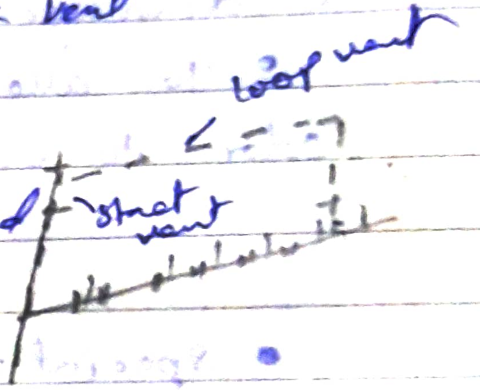


... called ... installed ... horizontal section ... piping below the ... flood level rim of the fixture served ...

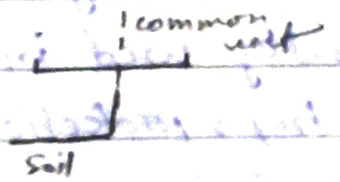


Loop Vent :

- A loop vent is a branch vent serving two or more traps
- Extends from the front of the last fixture to its connection with a stack vent
- The basic principal of this type of vent is that the flow of drainage does not exceed a one-half flow condition

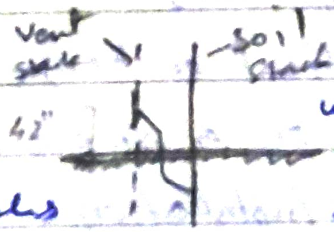


Common vent



Yoke vent -

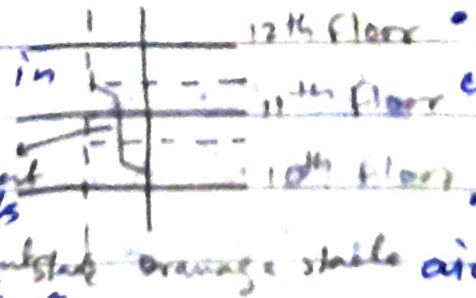
- for the purpose of preventing pressure change in the stacks



- It is a pipe connecting upward from a soil or waste stack to a vent stack
- Generally used in a high rise building

Stack Relief vent

- Soil and waste stack in building have more than 10 branch intervals shall be provided with a relief vent



- used in a conjunction with a vent
- Provide additional air circulation between a drainage system and venting system

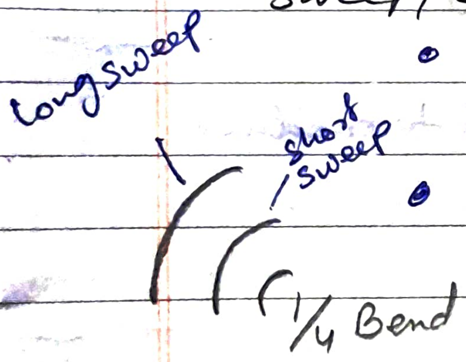
- Each relief vent should be installed at every tenth interval beginning with the top floor

- connect straight pipe with the other segment (coupling)
- Make turns (elbows/bend)
- Join intersecting (branch fitting)
- Allow the System to be unclogged (clean outs)

Drainage-waste-vent (DWV) and related fitting

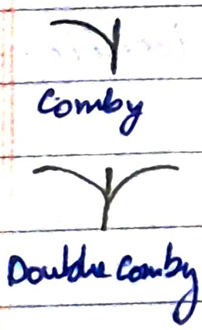
- Sweep Elbow (short sweep & Long sweep)
- Quarter Bend
- combo Wye with 1/8 (comby)
- Sanitary Tee
- Double Sanitary Tee
- Wye fitting
- clean outs
- closet flange
- Traps

Sweep/Bend



- DWV elbows are usually long radius or sweep types
- To reduce flow resistance and solids deposition, when the direction of flow is changed.

Combination of Wye & 1/8 Bend (comby)



- comby is a single fitting with the combition of wye & 1/8 fitting
- used in drain system to provide a smooth, gradually curving path

Sanitary Tee

San Tee

- used as a fitting for a soil pipe & all vent pipe
- Designed with a slight curve in the 90° transition

Double San Tee

Wye

- waste-fitting tee in which side inlet pipe enters at 45°

wye

- A standard wye is a Y-shaped fitting

Double Wye

- Allows one pipe to be joined to another at 45°
- Branch line is angled to reduce friction and turbulence

clean out:

- fitting with removable elements
- provides access to drains without removing plumbing fixture.
- Should be placed in accessible locations at regular intervals throughout a drainage system

Elbow

Long Radius (LR): R = 1.5D — 90° Elbow

Short Radius (SR) R = 1D — Street Elbow — 45° Elbow

Three types of clean outs are:

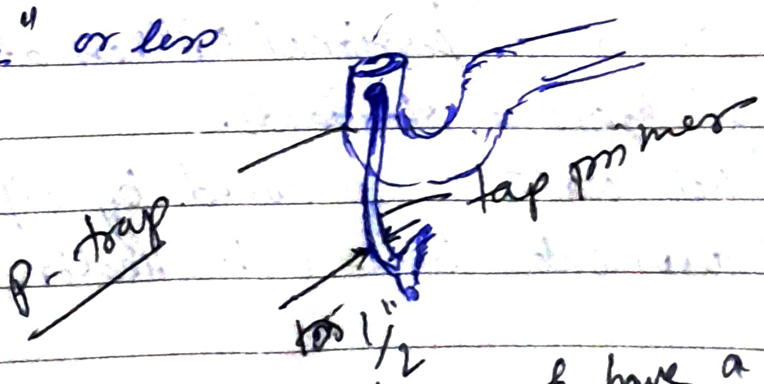
- Wall cleanout
- Floor clean out
- clean out.

- Traps:

- P-traps (are used because they prevent sewar gases from entering a building)
- The cut length over the trap should be alway 24" max

Traps primer:-

- Prevent floor drain traps from lossing their water seal by evaporation.
- Maintain the water seal to prevent the backflow of sewar gas into the building
- Also known as tap seal primer, or valve that adds water to taps.
- Must be installed on a cold water line of 1/2" or less



The tap primer valve must have a minimum elevation of 12" (305mm) Above the finished floor

DHW — 50-60°C
Tempered water - 29°-43°C

Pressure / Supply System:-

- Raw water (untreated) is collected from a surface water source (such as a intake on a lake or a river)
  - Can also be collected from a ground source (such as water well drawing from an underground aquifer)
    - collected within the watershed that provides the water resource.

- Domestic cold water:
  - Domestic water supply means the source and infrastructure that provides that ~~be to the fixture itself~~ to households
  - Piping that aids in delivering cold water to the proper places wheather that be to the fixture itself.

- Domestic Hot water:
  - DHW is normally supplied to taps and showers at temperatures of between 50-60°C
  - To a professional kitchen at 65°C, to satify hygiene standards.
  - Hot water is produced by different types of Equipment like water Heater, Boiler etc.

• Domestic Hot water Recirculating:

• Pipe line connected from the last point of hot water and return to source point of Hot water

• To maintain water temp. its called Hot water Return line or Hot water Recirculating line.

• Boosted cold water:

• Boosted cold water (BCW) is required when the cold water tank is located at a low level in a building

• Water needs to be pumped upwards for distribution.

• A BCW system typically comprises a cold water storage tank that supplies a number of pumps.

• Potable water:

• Potable/clean water system is a system of pipes which circulates clean water in the building

• This water source can be a public water supply from corporations/municipalities.

• Non-Potable water:

• Water that is not of drinking quality but may still be used for many other purpose, depending on its quality.

- Tempered water:
- Water having a temperature range between 85°F (29°C) and 110°F (43°C) is tempered water.
- The primary purpose is to control water temperature by mixing hot water with cold water
- Help in preventing scalding.
- Tempered Water Return:
- The pipe line by which tempered water returns back to source point for maintaining water temperature.
- Make up water:
- water which is added to compensate for losses, especially losses caused by evaporation.
- It is mainly used for different types of Mechanical Equipment (Boiler, Chiller, etc.)

Medical Gas

green — oxygen
yellow — medical Air {cu-pipe, pressure 345-380 kPa (50.0 - 55.1 psi)}
Blue — Nitrogen gas
— CO_2 gas
White — medical vaccum

Natural Gas - (CH_4) ; piping material -

Galvanized steel, Brass, Cu, Black steel

Type of Pipe Material: —

copper Piping, PVC Pipe, Steel pipe, Cast Iron pipe, Pex Piping, Brass Piping, Galvanized Pipe, HDPE Piping.

Copper Piping.

used: hot and cold water, refrigent line in HVAC

length: 20'-0"

Soft copper tubing

- can be bent easily
- More expensive
- mostly used in refrigerant line, heat Pump.

Hard/Rigid copper:

- can not bent
- neet fitting for change direction

Type L

- interior plumbing system
- most commonly used among 3
- hard and soft both avaliabe

Type M

- thinest of 3
- used in Vaccum system
- hard/soft both avaliable

Type K

- thickest among 3
- use in water, oil distribution system, fire protection.

Schedule 40 (SCH-40) is thinner than SCH-80

PVC piping

material: PVC (Poly Vinyl Chloride)
use: hot, cold water supply, sanitary waste, vent
length: 20'-0"

Plain PVC

- less cost
- light and corrosion resistance
- Thermostatic nature

UPVC (unplasticized polyvinyle chloride or rigid PVC)

- rigid material
- waste water transport

CPVC (Chlorinate PVC)

- Higher level of chlorine content
- withstand temp.
- water distribution

Steel piping:

Made: Carbon steel or stainless steel.
length: 21'-0"
join: Threaded, Grooved, weld
used: water line of domestic for, mechanical piping oil, or gas.

Cast Iron Pipe

- Material: cast Iron
- used: waste and sanitary
  - Hub cast Iron
  - No-Hub cast Iron
- length: 10'-0"

Pex piping.

- flexible
- can't use in outdoor as UV ray damage
- 50 - 1000 feet ~~cont~~ roll

Galvanised Piping

- protective Zn coated to prevent corrosion and rust
- used: water supply
- length: 21'-0"

Brass piping

- Alloy of Cu & Zn, (Cu - 67% - 85%)
- length: 12'-0"
- hot water distribution

HDPE pipe (High densicity polyethylene)

- high pressure
- Subsoil draining piping
- length: 50'-0"

Street Elbow - external threading elbow.

Water Supply and related fitting:

- Elbow (90°, 45°, 22.5°) { LR (long Radius) - 1.5 times; SR (Short Radius) - 1.0 times }
- Tee (Straight Tee & Reducing Tee) — Branch
- Reducer — concentric Reducer, Eccentric Reducer
- Cap
- Coupling - union, Dielectri Unio
- Nipple { both side tread, used to reguatling or measuring fluid flow
- Adapter { ~~Sweep~~
- O-let

Type of Pipe joint:

- Threaded joint (by screwing with the help of treads)
- Brazed joint (filler material 840°C↑, Tin, Ni, Bi, Silver, Cu) use for Cu pipe
- Soldered joint (filler materi 840°C↓) used for Cu Pipe
- welled joint (butt, Socket welled) → Socket form joint of 2 different dia pipe.
- Flaged joint (mechanical join)
- Press-fit joint
- Grooved joint
- Coupled joint
- Expansion joint (Designed to absorb the temp. indued/vibration)

• Sweep Elbow (S-Sweep & L-Sweep); Quater Bend; Combo wye with (1/8 Conby); Sanitary Tee; Double Sanitary Tee; Wye fitting; Clean Outs; close + Flange, Traps.

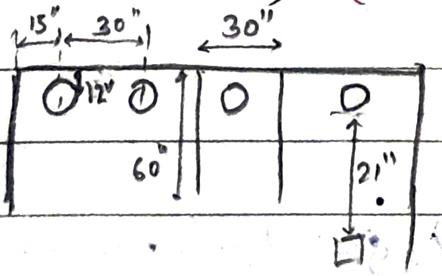
Plumbing fixture

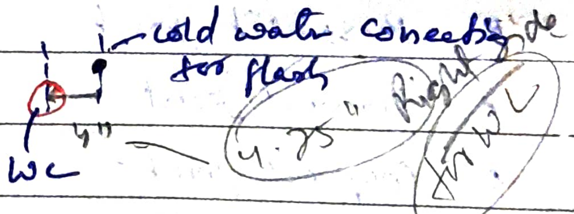
- Water closet (WC)
- Urinal
- Lavatory / Sink
- Kitchen Sink (waste outlet not less than (1 - ½")/38 mm
- Floor Sink
- Shower
- Bath Tub (2 waste outlet | 1- main, 2- overfall)
- Bidets (washing inner buttocks, arms)
- Floor Drain
- Gulley Trap
- Channel Drain/Trench Drain
- Area Drain
- Hose Bib (It is a tap, having one mouth for fitting gardening pipe point)
- Drinking Fountain
- Eye washer
- Roof Drain (one main, another overflow || used as indicator)

- ~~Floor Drain~~ wall & Floor Mounted

Same for urinal

WC (water closet)

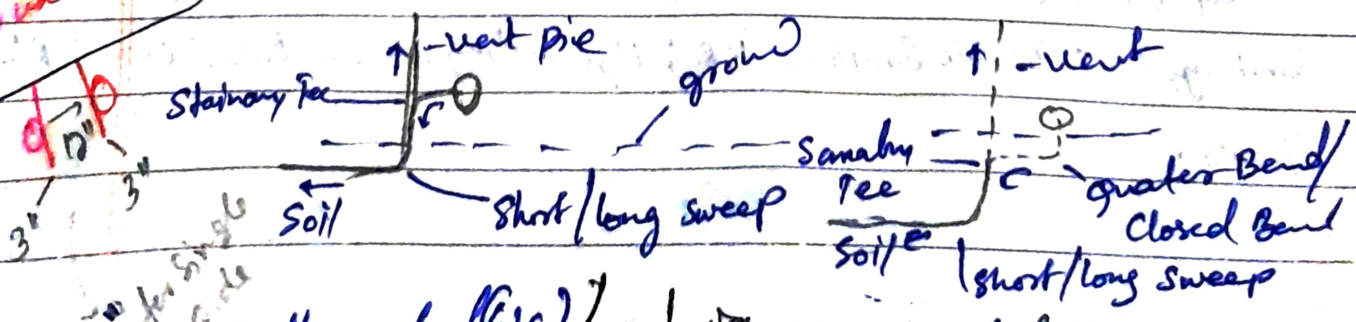




O – WC

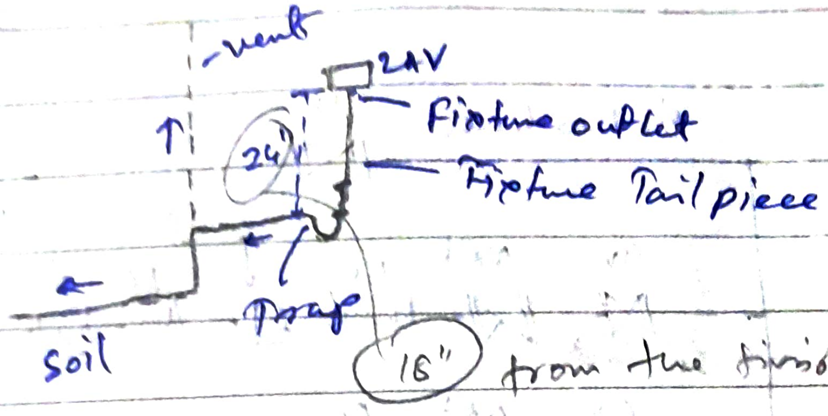
□ – Tub

For wall mounted WC carrier fitting is used to hung



wall mounted (WC) / urinal connection   Floor Mounted WC

Lavatory / Sink

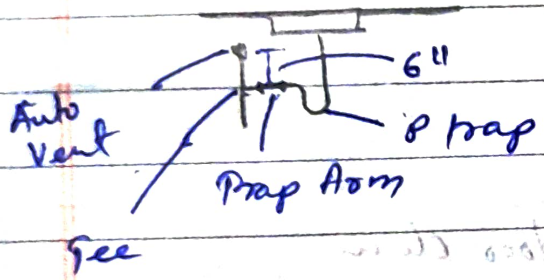


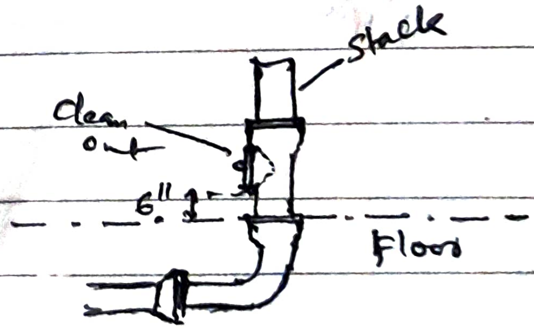
16" from the finish floor

Cold water
Right side
Hot water
left side

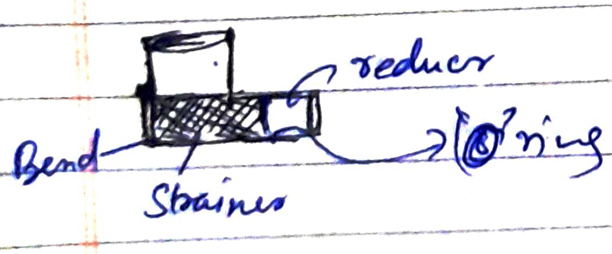
Floor Sink

4" for Lavi



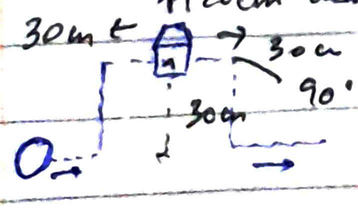


Section Diffuser: (strainer, Bend, reducer)



clean out
- wall clean out
- Floor clean out
- clean out

Water Meter:-

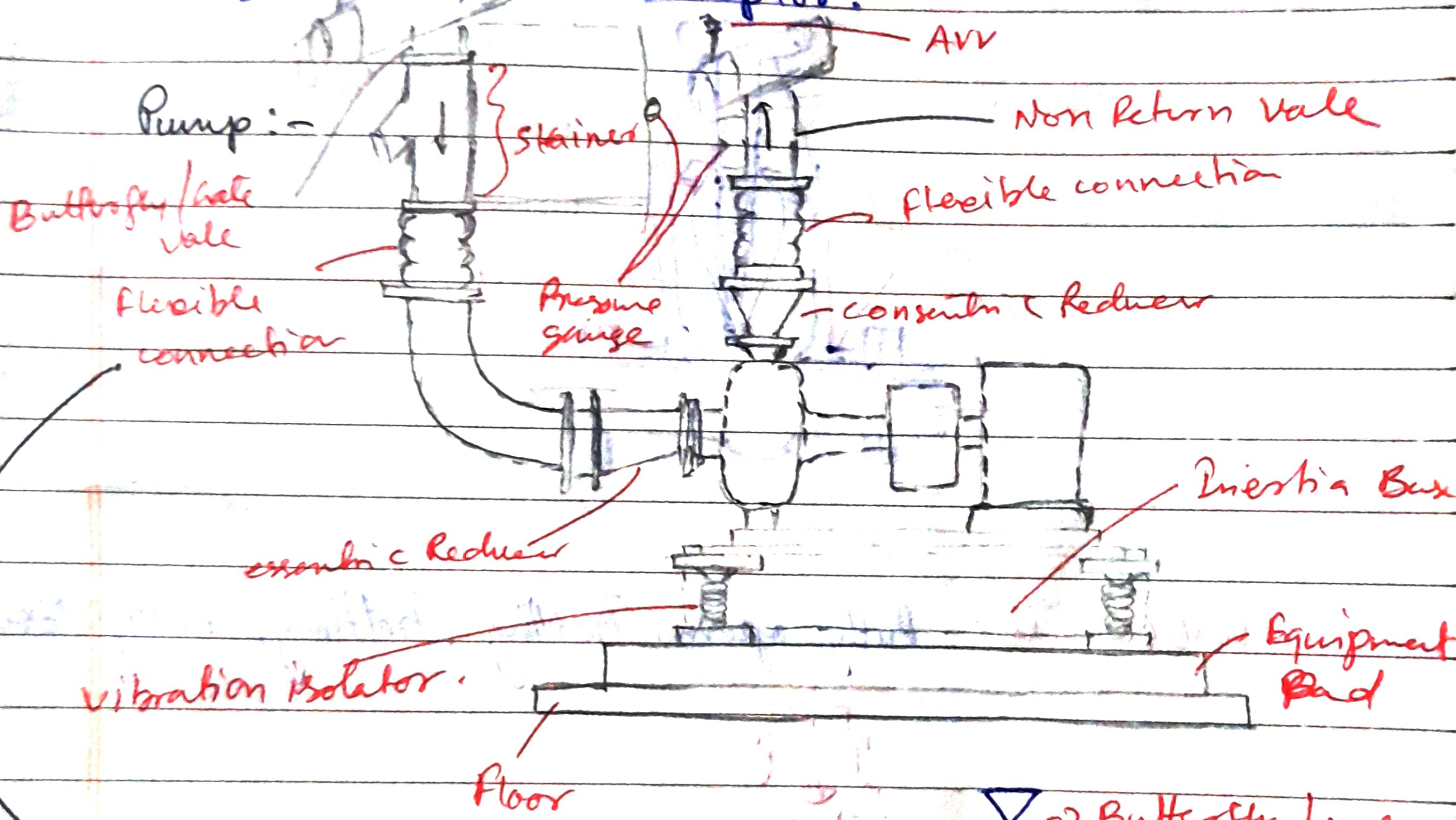


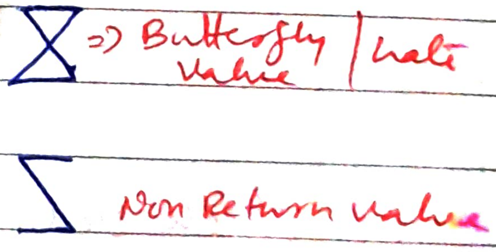
Plumbing Equipment/Device.

The most common plumbing equipment's/device

• Pump, • Water Meter, • Expansion Tanks, • Air Seperator
• Water Heater, • Garbage Disposal, • Hot Water storage Tank, • Interceptor.

Pump :-





Primary fn is to reduce the transmission of noise, shock, and vibration produce by the pump.

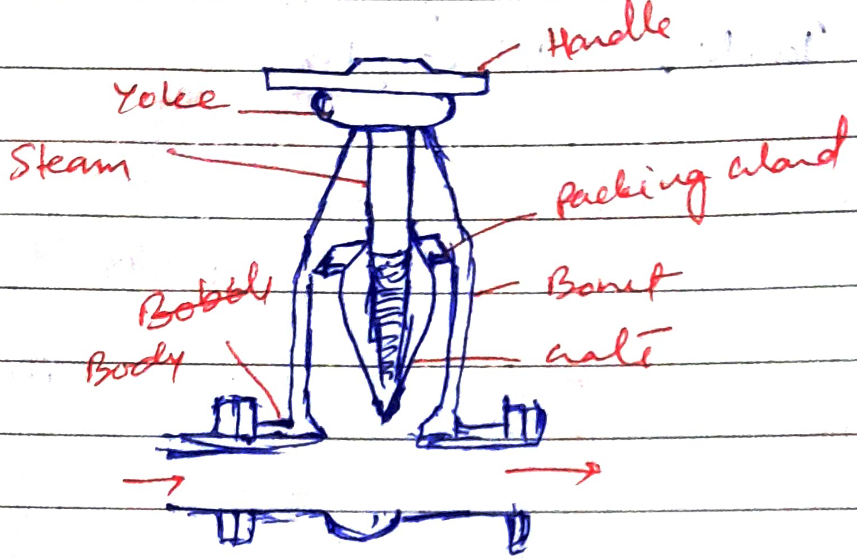
Different type of pump :— Booster pump, condensate pump, Hot Water Re-circulation pump, Transfer Pump, Sump pump

Endline/Suction Pump | In line Pump.

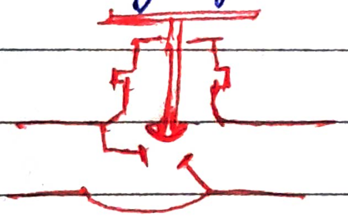
• The liquid turns

: Value :

Gate Value :- closed, open

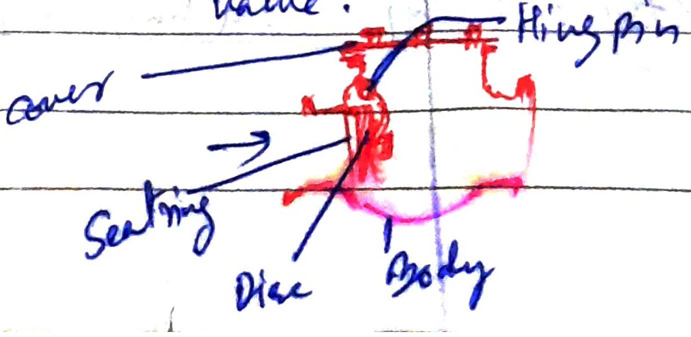


Globile Vale : fully open, Throttling, Throttling, Fully closed

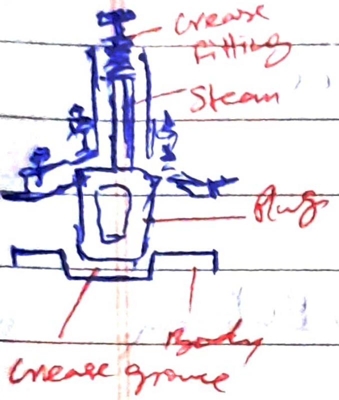


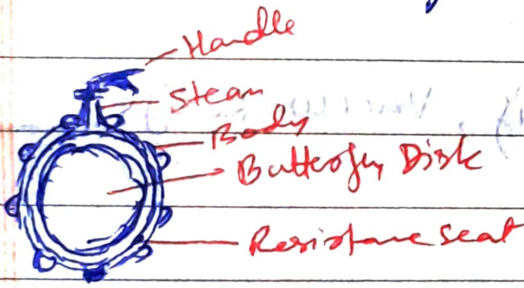
Check value : (swing type)

- prevent back flow
- one way direction value
- The pressure of the fluid passing through a pipeline opens the value
- Any type of reversal of flow close the value.

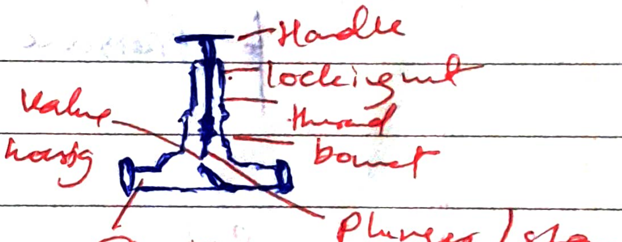


Plug valve:
- A quater-turn rotary motion valve
- uses a tapered or cylinder plug to start or stop the flow
- plug shaped disk, which has a passage to pass the flow
- used as on-off stop valves
- capable of providing bubble tight shutoff
- used in vaccum to high-pressure & temperature applications

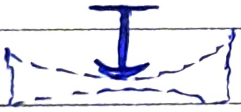




Butterfly valve



Needle valve



Pinch valve (clamp valve)

Based on Function

- Isolation
  - Gate, Ball, Butterfly valve
- Regulation
  - Globe, Needle, Gate, Ball, Butterfly
- Safety Relife :
  - Pressure Relif, Vaccum Relife
- Non-Return
  - Swing check value
  - Check value
- Speical Purpose
  - Floate valve

Based on operation

- = Manual
  - Hand wheel, Hand levers, Gear wheel, chain
- = Power,
  - Electic / Motor, Air / Pneumatic, Hydraulic, Solenoid
- = Automatic

Based on Motion

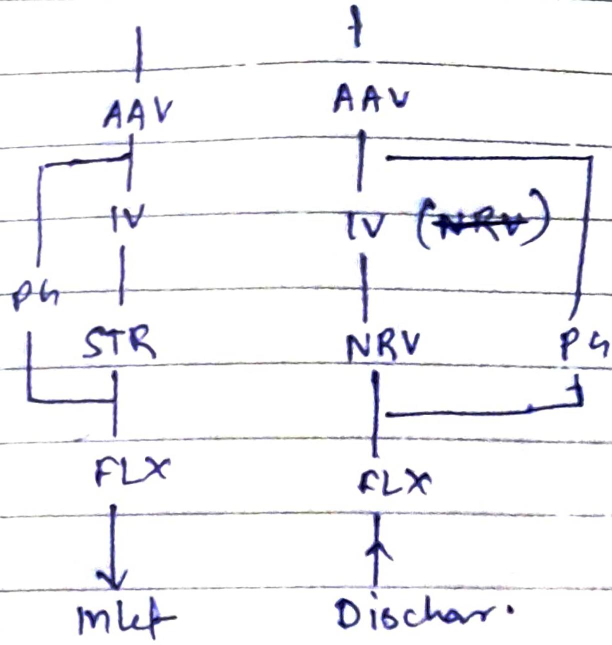
- Linear Motion: Gate, globe, diaphragm, Pinch (allow, stop, throttle)
- Rotary Motion: Butterfly, ball, plug, eccentric- and swing check valve
- Quarter Turn Valve: Some rotary motion valves requires approximatly a quater turn 0 through 90, motion of the steam to go to fully open from a fully closed position visc-versa.

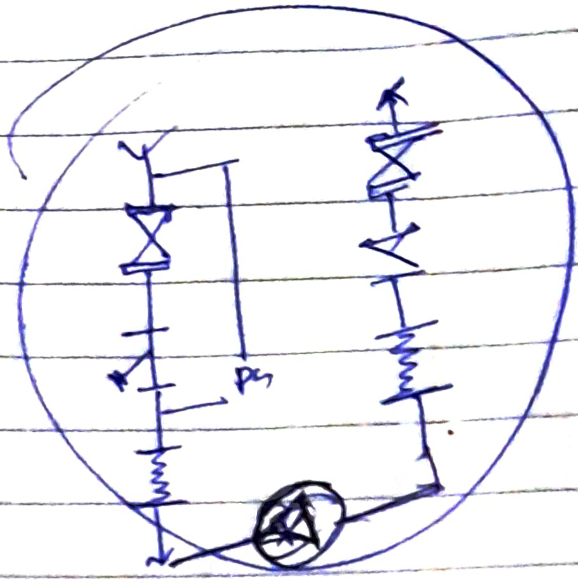
Valve type	Liner Motion	Rotatory Motion	Quarter Turn
Gate	Yes	No	No
Globe	Yes	No	No
Plug	No	Yes	Yes
Ball	No	Yes	Yes
Butterfly	No	Yes	Yes
Swing check	No	Yes	No
Diaphragm	Yes	No	No
Pinch	Yes	No	No
Safety	Yes	No	No
Relief	Yes	No	No

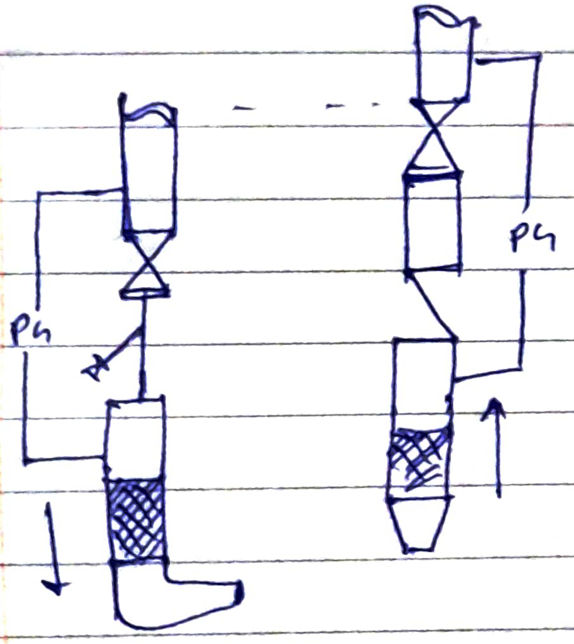
Handle

Butterfly, Ball, Plung

Globe value / Gate value upto → 65 ø
Butterfly value above & → 80 ø
ø = dia







- length + 200 mm space Required at motor side for replacing and maintance space
- 550 mm + pipe dia for minimum space for Inlet pipe connection
- 500 mm for Operator for controlling the values
- Minimum space at side 150 mm to 200 mm
- keep min space b/w pipes 150 mm Edge to Edge
- keep min 7'0" elevation from ground level (for Plant Room)

The following steps are to be followed during plumbing Model.

- follow the specification checklist
- Study Building type
- fixture submital
- Study for the invert elevation of pipe
- Careful study of the plumbing fixture position
- Before starting model set the fly zone
- Take a note for WC type
- Aware of the no flying zone for the building
- If WC carrier is used then study for the same
- for pressure pipe modeling try to keep the pipes in group
- fixture schedule.

The following steps are to be following during Pumbing Modeling.

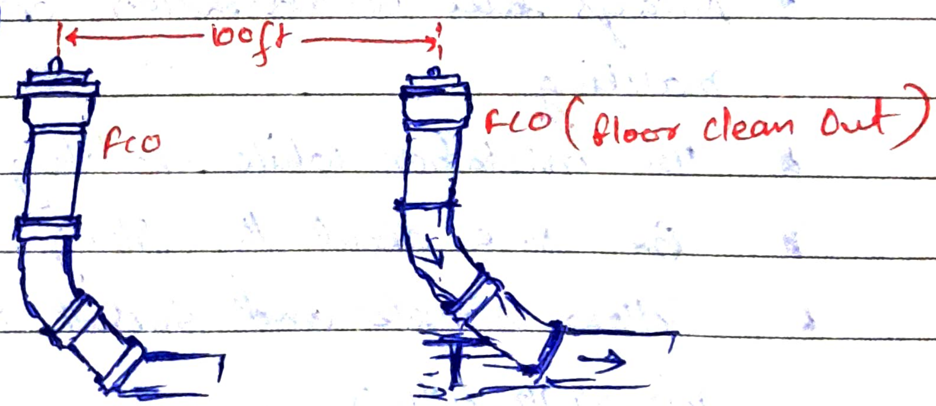
- Always take consideration about Hanger while modeling
- Use insulation while modeling
- Be sure about the fitting and connection type
- Follow simple and shortest route and try to use minimum fitting.

The following steps are to be followed during plumbing Modeling:

- Riser should be up through the wall and wall size is sufficient to run the pipe inside it.
- Similarity in connection should be maintained for the similar type of fixture.
- Keep in mind the access for maintenance for the equipment.
- If there is a missing information/discrepancy in contract document, Raise an RFI
- Mark the area with a cloud and mention the related RFI no. (if not answered by the client)

⊛ Clean Out

- Clean out must be provided every 100ft / 30Mt. in horizontal drainage line in a building.

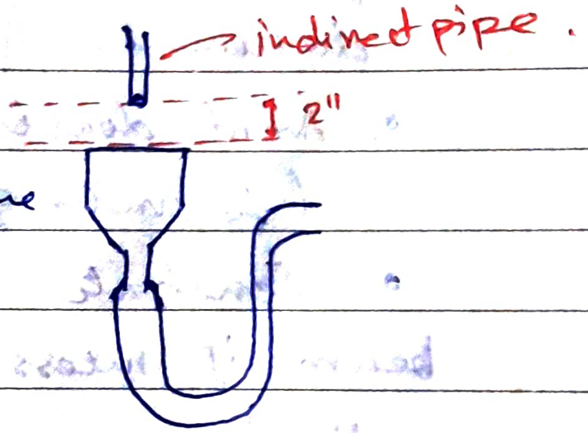


Elevation View

- The smallest buildin sewer that requiring a manhole is of φ8"
- Every clean out must allowing in the direction of flow
- Minimum nominal clean out for an interior 6" drainage pipe is 4"
- Minimum clearance for clean-outs for rodding piping that's 6" or smaller is 18"

Indirect waste piping:

- The air gap between indiret pipe and the rim of the floor any fixture shall be 2"



Traps

- The maximum vertical distance by the the IPC from the fixture outlet to its traps wer is 24"
- Each plumbing fixture must be seperately trapped with an exception of WC and urinal.
- A fixture traps shall not be longer than drainage pipe it discharge into.
- S-Trap can never be used in a plumbing system as Prohibited in IPC.

- IPC prohibits extending a clothes washing standpipe than 42" above its traps.
- A Trap Primer connection should be linked to the traps connected to FDs to maintain the water seal.

Consideration Before Underground Plumbing.

- Collect the information. It is necessary to go through the General notes of contract document.
- Avoid double fitting and complicated routing (for under ground)
- Penetrate middle third of the structural beam if necessary. Must be approved by client
- Must consider in our modeling area extend up to 5ft from the exterior wall.

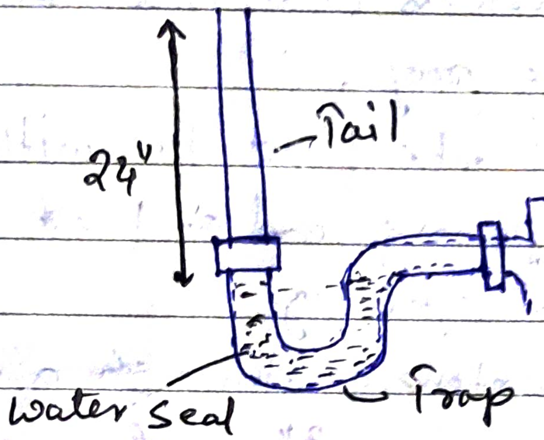
Plumbings Guideline:

- 2" pipe must be pitched at 1/4" per foot
- 3" and greater must be pitched at 1/8" per foot, if needed 8" and larger can be pitched at 1/16"
- Route drains as close to fixtures they are serving

- Sanitary pipe should go generally be run as high as possible.
- Pipes should not be offset in a stud wall and
- when pipe turns down into a wall the pipe should be extended to the fixture elevation
- The vent extensions (VTR) shall be run at least 7 feet above the roof.
- Vent terminal shall not be with in 10' horizontal of air intake opening and at least 2' feet above the top of that opening.
- Every vent extension through a roof or wall shall be a minimum of 3" in diameter.

4.1 ① What is a P-Trap? And why its is use?

Ans: P-trap is a p-shaped bend pipe used in drainpipes to connect sink, tubs, and other plumbing fixtures directly to the sewar system or septic tank.



- Stops sewar gases from passing into the home by creating a water seal

- Helps maintain the natural flow of water by acting as a half-filled reservoir, making flushing and draining easier.

4.2 ① What is Black water?

Black water is waste water that contains human waste (fecal matter) such as

- toilets; • Urinals; sometimes kitch sinks and dishwasher (because of food scraps, grease, e

② Functions of vent

Ans • Prevents Airlocks & Maintain Pressure
— Helps keep the air pressure in the pipes blanced, so wastewater flow smoothly
— Without a vent, water can gurgle or even stop draining.

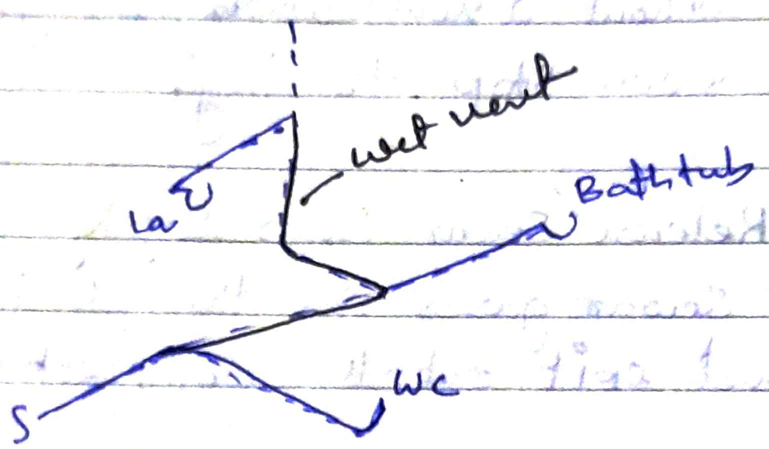
• Release Sewar Gases Safely
— Sewar gases rise through the vent pipe and exit out the roof, ~~not in~~

• Stop Water in P-traps from Being ~~St~~ Siphoned.
— When water flows down a pipe, it creates suction. A vent let in air to break that suction, so the P-trap doesnot empty out.

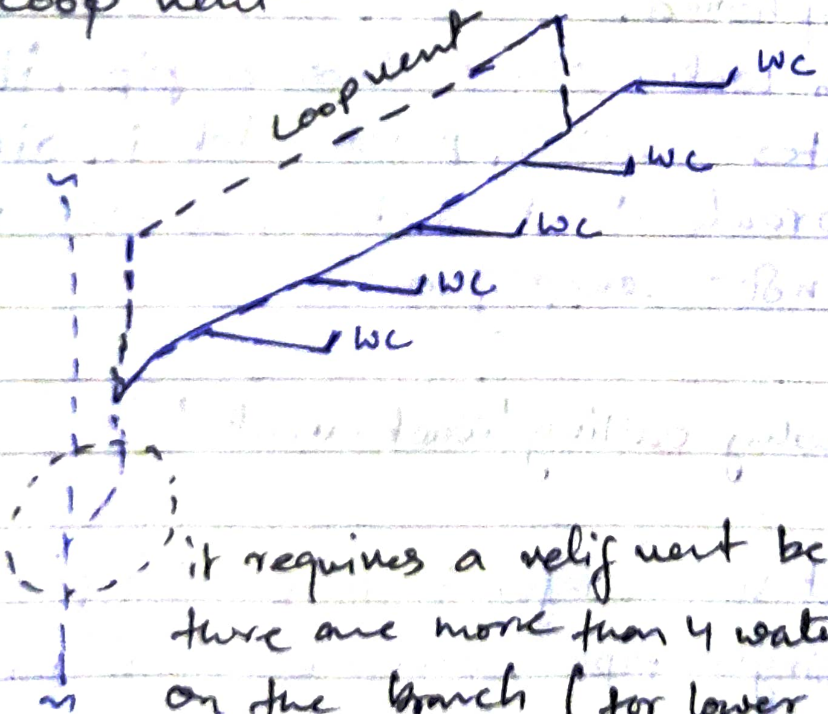
③ Reason of why calling 'wet vent'

Ans: The term 'wet vent' refer to a plumbing system where a single pipe serves ~~as~~ dual purpose:

- it functions both as a drainage pipe (carrying wastewater).
- and a vent (allowing air to flow into the system to prevent suction and maintain air pressure).

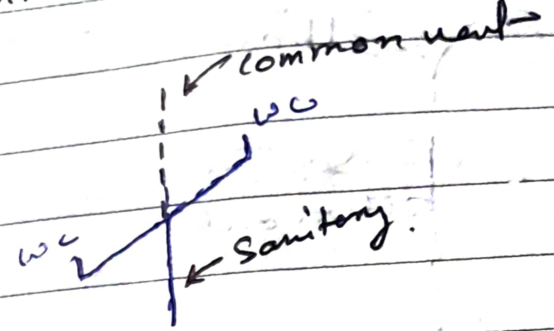


Loop vent

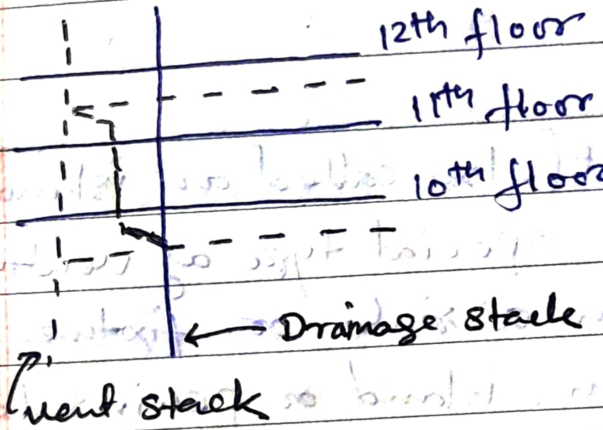


it requires a relief vent because there are more than 4 water closets on the branch (for lower portion)

common vent :-



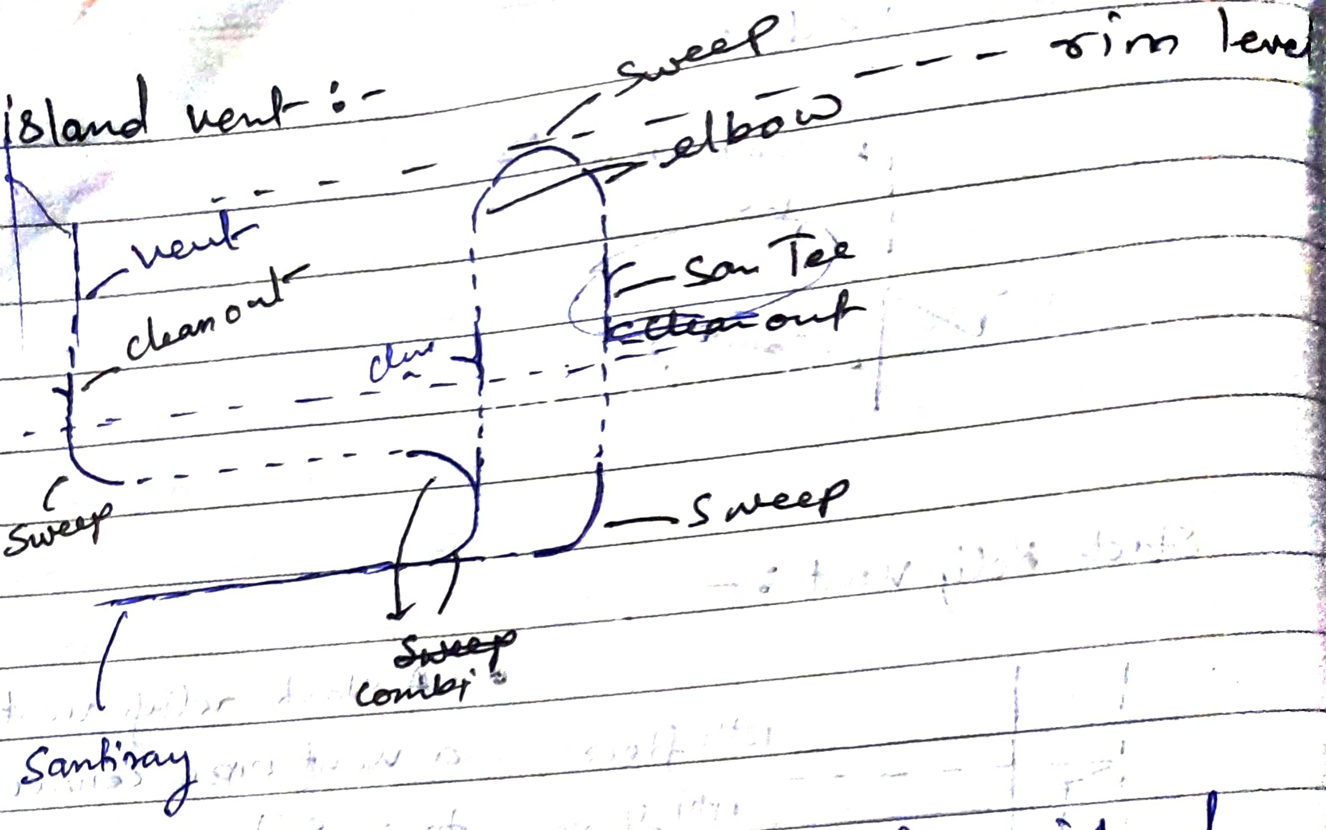
Stack Relif vent :-



- A stack relief vent is a vent pipe connected to a soil or wast stack, designed to relieve pressure and maintain proper airflow in large or tall plumbing system, especially where multiple stories or heavy discharge can created pressure problem.

- Each relife vent should be installed at every 10th interval beginning from the floor.

island vent :-



— An ~~ve~~ island vent (also called an island fixture vent) is a special type of venting system used when a sink or fixture is installed in an island or peninsula, where there is no nearby wall to run a traditional vertical vent pipe.

Standard Length of Pipes

Length	Pipe
20' 0"	cu, PVC
21' 0"	steel, galvanised pipe
12' 0"	Brass
10' 0"	cast Iron
50' 0"	HDPC

~~Flex~~
Pex
50 - 1000 feet roll

UPVC : Unplasticized PVC , PVC (poly vinyle chloride)
CPVC : Chlorinated PVC ,

Imp point :—

- Plumbling Guidline :—
  - → The vent extensions (VTR) shall be run at least 7 feet above the roof.
  - → Vent terminal shall not be within 10 feet horizontally of air intake opening and at least 2 feet above the top of that opening.
  - Penetrate middle third of the structural beam if necessary. Must be approved by client
  - Must consider in our modeling area extend up to 5 feet from the external wall.
  - Each plumbling fixture must be seperately trapped with an exception of water closet and urinal.
  - A trap Primer connection should be linked to the traps connected to FDs to maintain the water seal

"All fixture traps must be self-scouring except for grease traps." explain why?

Ans. Every plumbing fixture (like a sink, shower, toilet etc) must have a trap that cleans itself automatically with regular water flow, except grease traps
Because grease traps are specifically designed to trap grease and solids – they don't let everything flush away like normal traps do, so they aren't supposed to be Self-scouring. Instead, they need to be cleaned manually or maintained regularly

Valve :—

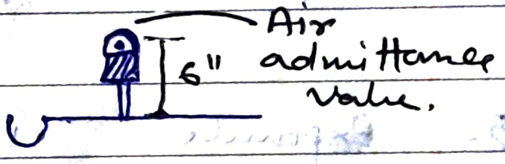
1. Circuit Setter
   - A balancing type valve
   - It is used for flow blancing, flow metering & shut off.
   - commonly applicable in hot water return system
   - Generally made with Brass

2. Thermostatic Mixing value

- Provide a safe, stable temperature
- used to adjust the temperature of the water
- Automatically, mixes the correct amount of hot water comming out of the water heater with cold water
- Normally used for Bathtub, showers, Lav, sink etc.

3. Air Admittance Value :-

- One way vents installed after the trap on the drain line of a fixture
- Designed to address negative air pressure in the drain system, created when a fixture is drained.



Trap Prime — Trap — AAV

Difference b/w backflow preventer and check val..

	Feature	Check valve	Backflow Pre..
1.	complexity	Simple, one-way valve	complex, often include check valve other parts.
2.	Purpose	Prevent reverse flow	Protects drinking water from contamin..
3.	Regulation	Not certified for health protection	Usually certified (eg. by plumbing cod..
4.	Maintenance	Minimal	Periodic testing and maintenance requ..
5.	Example	In a pump line	Between main wat.. line and irrigation s..